Zooids: Building Blocks for Swarm User Interfaces

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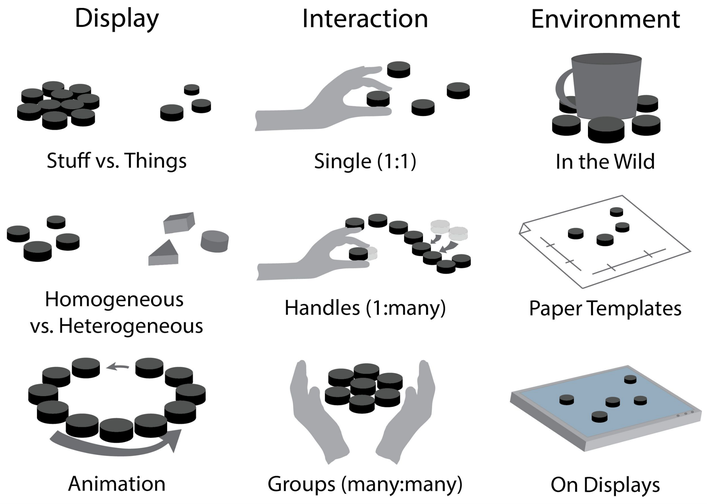
A **zooid** or zoöid /ˈzoʊ.ɪd/ is a single animal that is part of a colonial animal. **Zooids** are multicellular; their structure is similar to that of other solitary animals.

SWARM USER INTERFACE

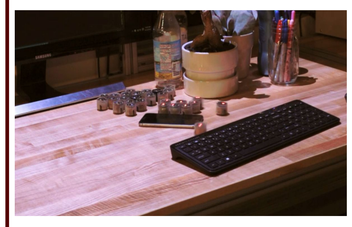
"human-computer interface made of independent self-propelled elements that move collectively and react to user input"

DESIGN SPACE

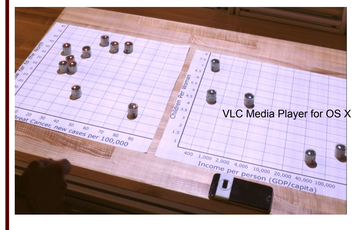


EXAMPLE APPLICATIONS

(Environment)



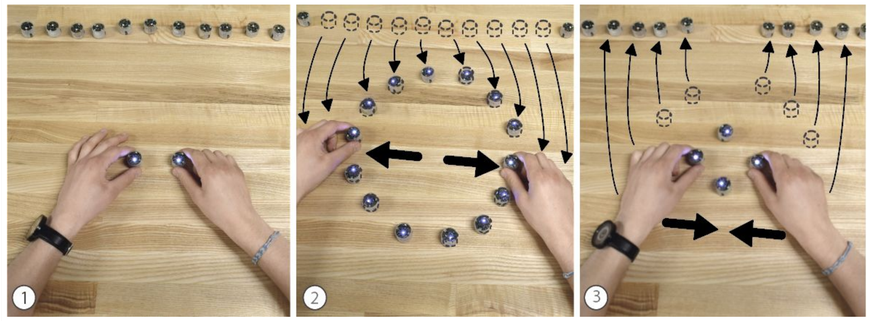
In the wild
Zooids are self-propelled elements and thus can be deployed on any flat surface. This enables usage under normal desktop conditions as shown right to combine with our other everyday objects.



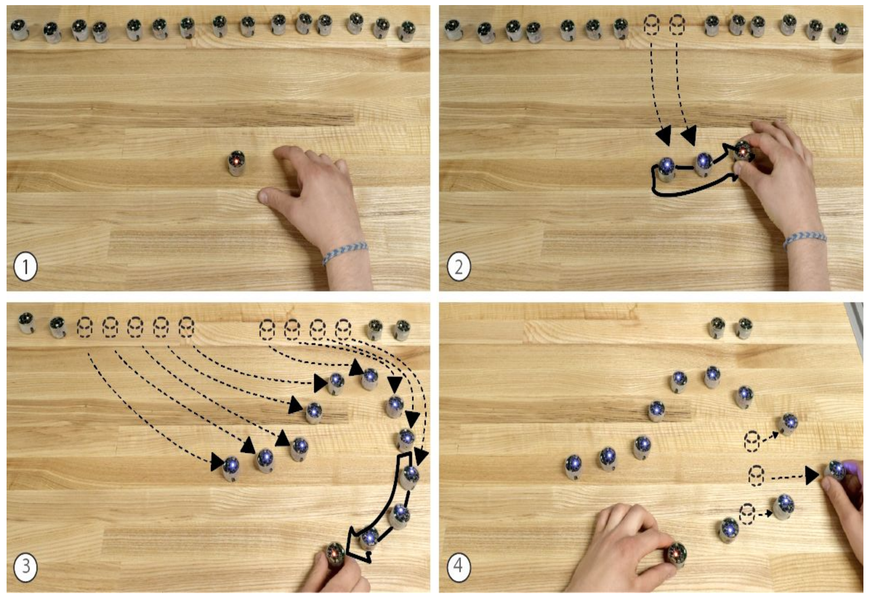
Extra Visual Feedback
While Zooids can be used alone, when finer details are needed, zooids can be combined with other visual feedbacks such as paper or screen placed underneath.

EXAMPLE APPLICATIONS

(Display & Interaction)



Shapes
Zooids can be used as tools for drawling lines, rectangles, and circles using the rubber band technique from desktop applications. Here, two zooids are used as control points to define the circle's diameter, and idle zooids automatically position to complete the shape.

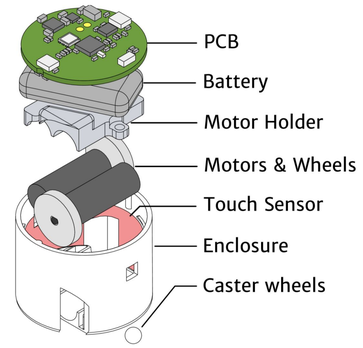


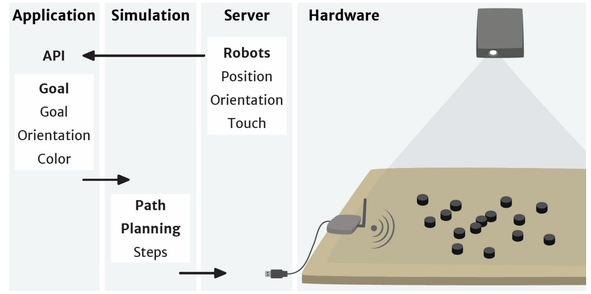
Freehand Drawing
This is a swarm version of a freehand drawing tool. Initially, only the drawing zooid is placed in the center. Then, as the user moves the drawing zooid, the previously idle zooids fill the path. The curve can also be deformed physically by manually moving the zooids.

DESIGN

Hardware

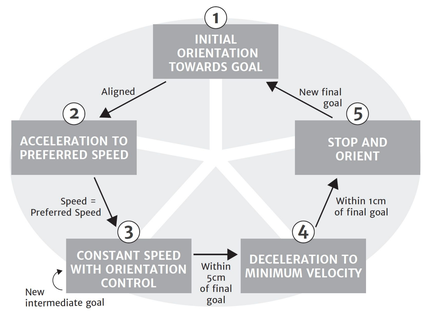
As shown right, each robot consists of PCB, battery, motors, wheels, touch sensor, enclosure, and caster wheels.





Software Architecture

The overall system consists of 4 layers and communicates with each other as shown above.



Control Strategy

The control procedure for our system consists of three steps:

- Hungarian goal assignment (optional)
- HRVO global control strategy (optional)
- PID position control (as shown above)

Resources available at: https://github.com/ShapeLab/SwarmUI